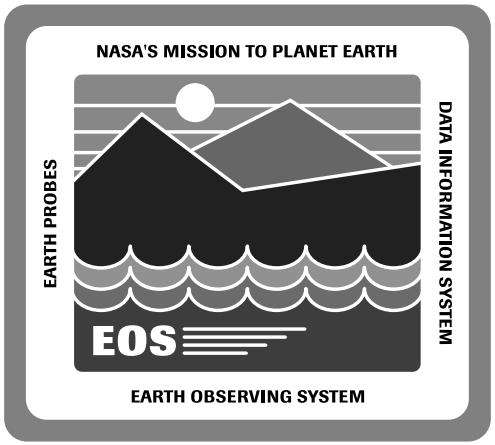


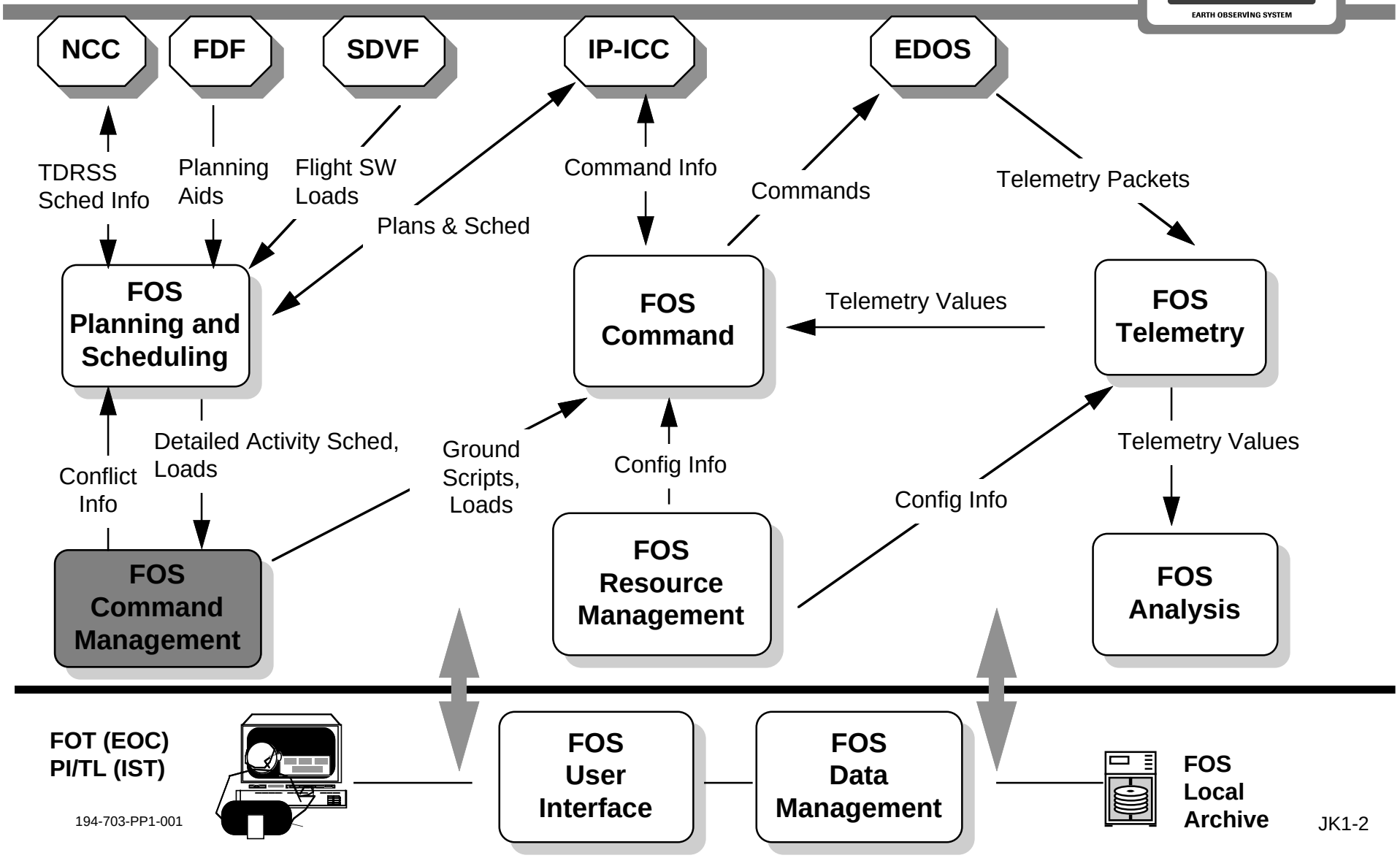
Command Management

Jon Kuntz

System Design Review - 28 June 1994

SDS - 5.4.2

FOS Subsystem Diagram



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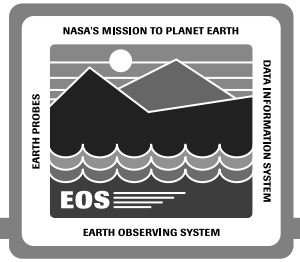
Command Management Subsystem Outline



Command Management Overview

- **Command Management Functions**

Command Management Design Drivers

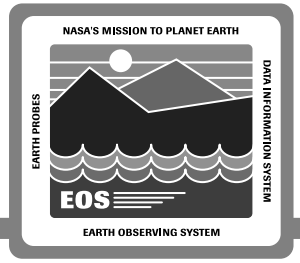
Command Management Subsystem Context

- **Context Diagram**
- **Context Diagram Description**

Command Management Subsystem Design

- **CMS Object Model**
- **CMS Object Model Description**
- **CMS Scenario - Detailed Activity Schedule Processing**
- **CMS Scenario - Memory Image Processing**

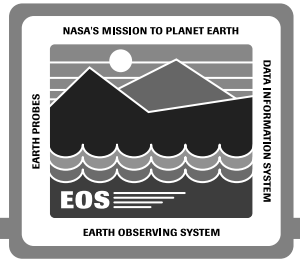
Command Management Subsystem Overview



The primary function of the CMS is to provide for the planned commanding of EOS spacecraft and their instruments. This includes:

- **Generation of loads and ground scripts from activities in the Detailed Activity Schedule**
- **Generation of table loads from FDF data**
- **Validation of externally-generated loads**
- **Preparation of loads for uplink**
- **Maintenance of ground reference image**
- **Maintenance of memory-to-command map**
- **Creation of memory dump images from collected dump data**
- **Comparison of memory dump images to ground reference image**
- **Validation of preplanned command procedures**

Command Management Design Drivers



Increased automation of routine control center activities

- **For daily load generation**
- **For real-time contact operations**

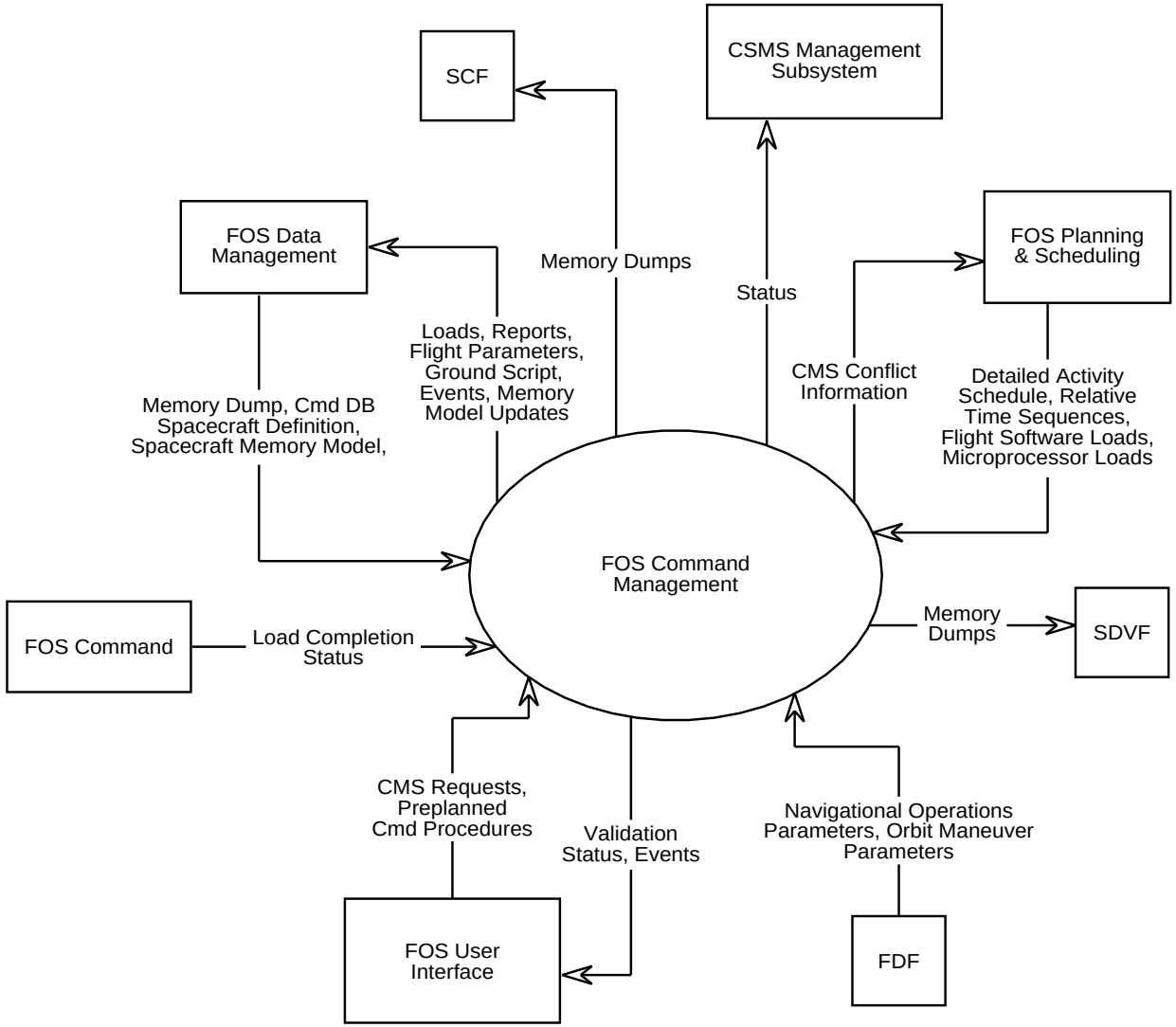
Seamless integration of planned commanding functions

- **Planning & Scheduling**
- **Command**

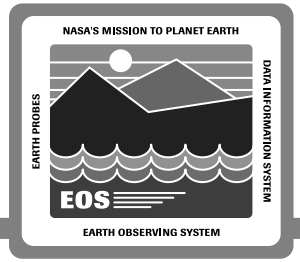
Maximized reuse potential of command management software

- **Object oriented approach**
- **Incorporate best features of existing systems**
- **Lessons learned from previous development efforts**

Command Management Context Diagram



Command Management Context Description



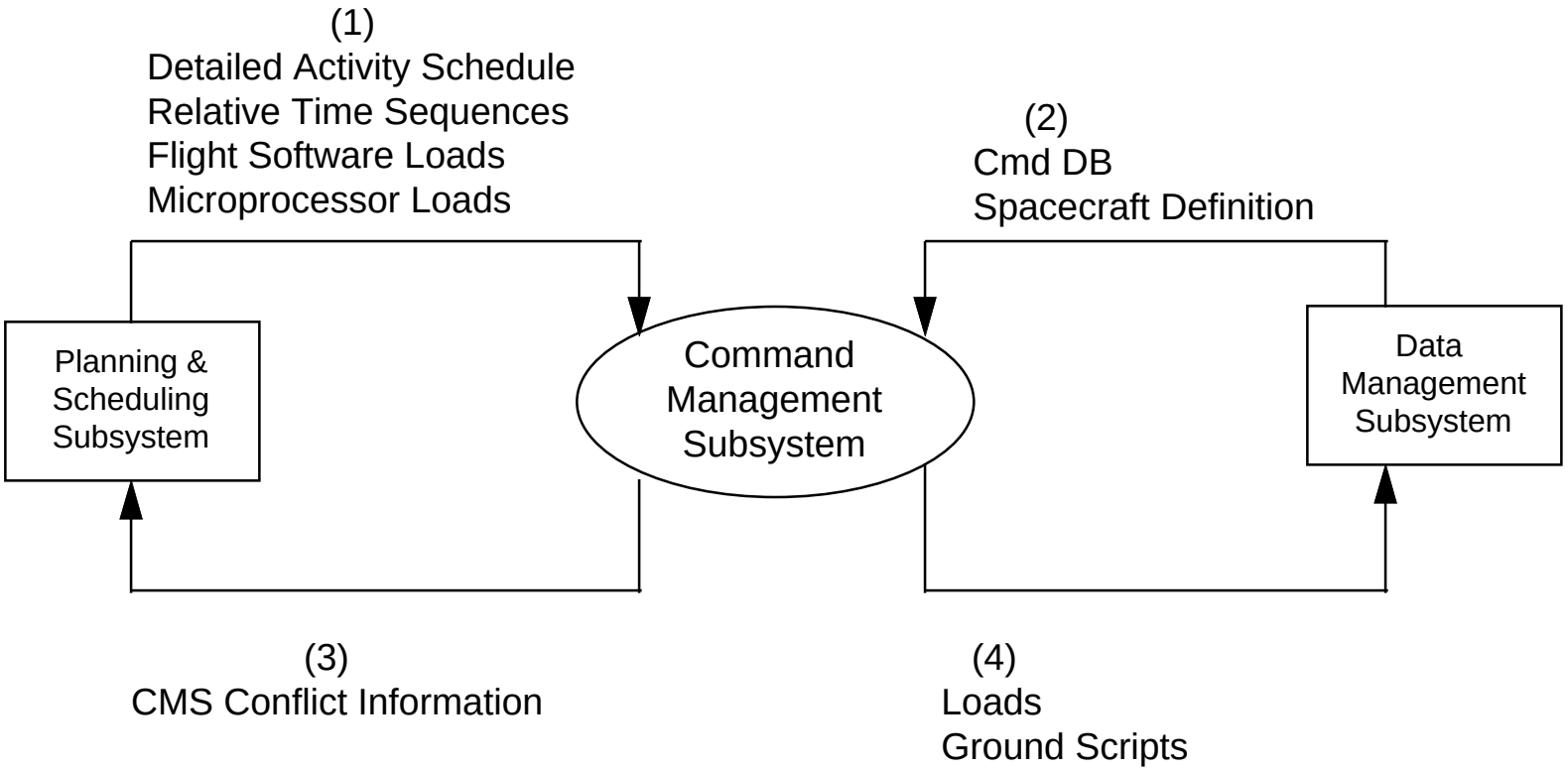
Key interfaces supporting load generation:

- **Planning and Scheduling subsystem for Detailed Activity Schedule (DAS) Processing Scenario**
- **Flight Dynamics Facility (FDF) for Table Load Generation Scenario**
- **Data Management for both scenarios**

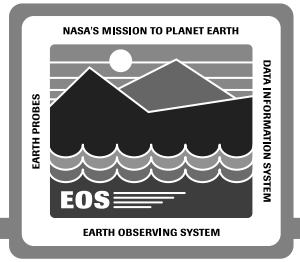
Other key interfaces:

- **Command subsystem for Load Completion Status**
- **SDVF and SCF for Memory Dumps**
- **User Interface subsystem for Preplanned Cmd Procedures**
- **Data Management subsystem for storage of Memory Model**

CMS Detailed Activity Schedule Processing Scenario

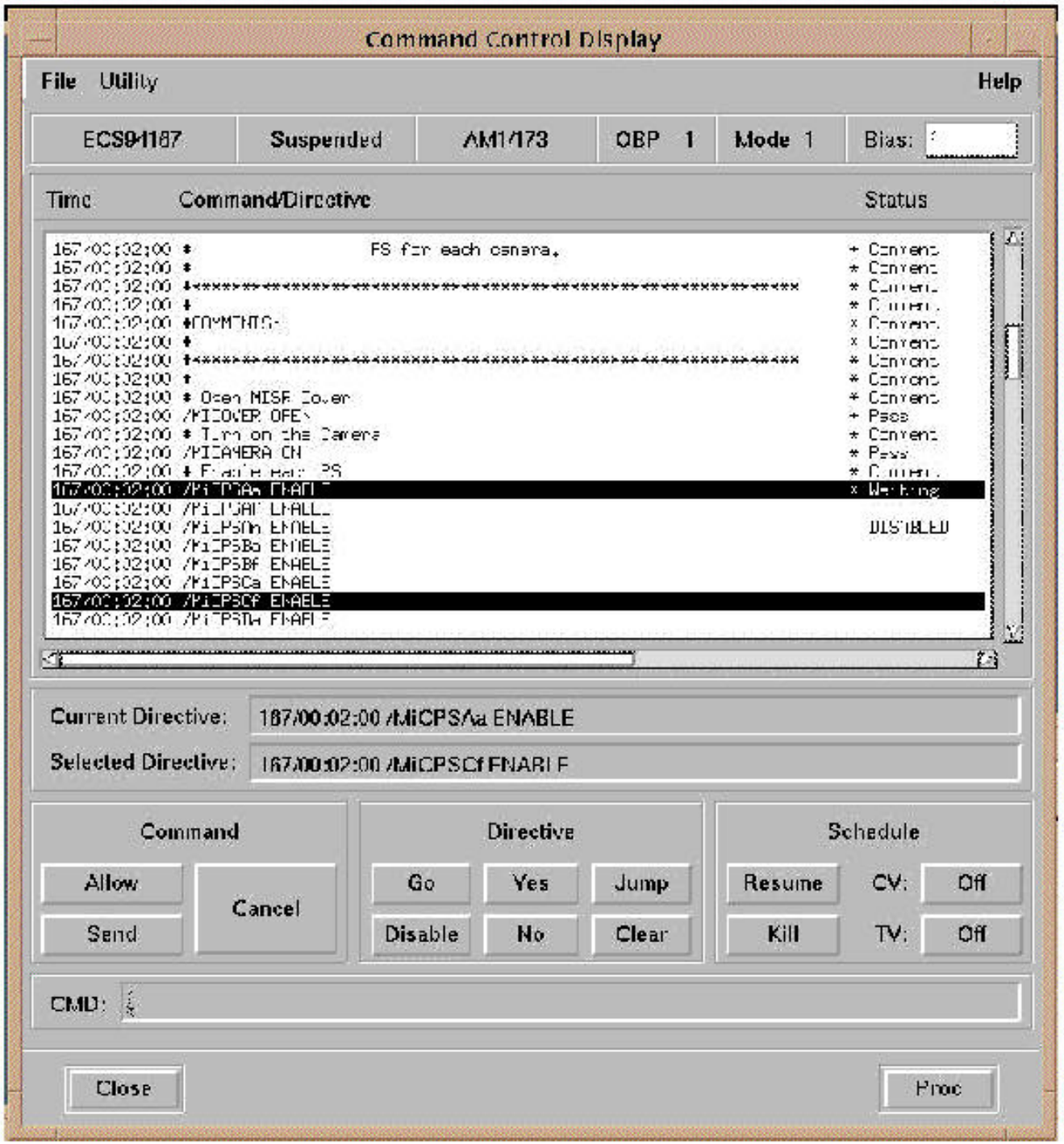


CMS Detailed Activity Schedule Processing Scenario

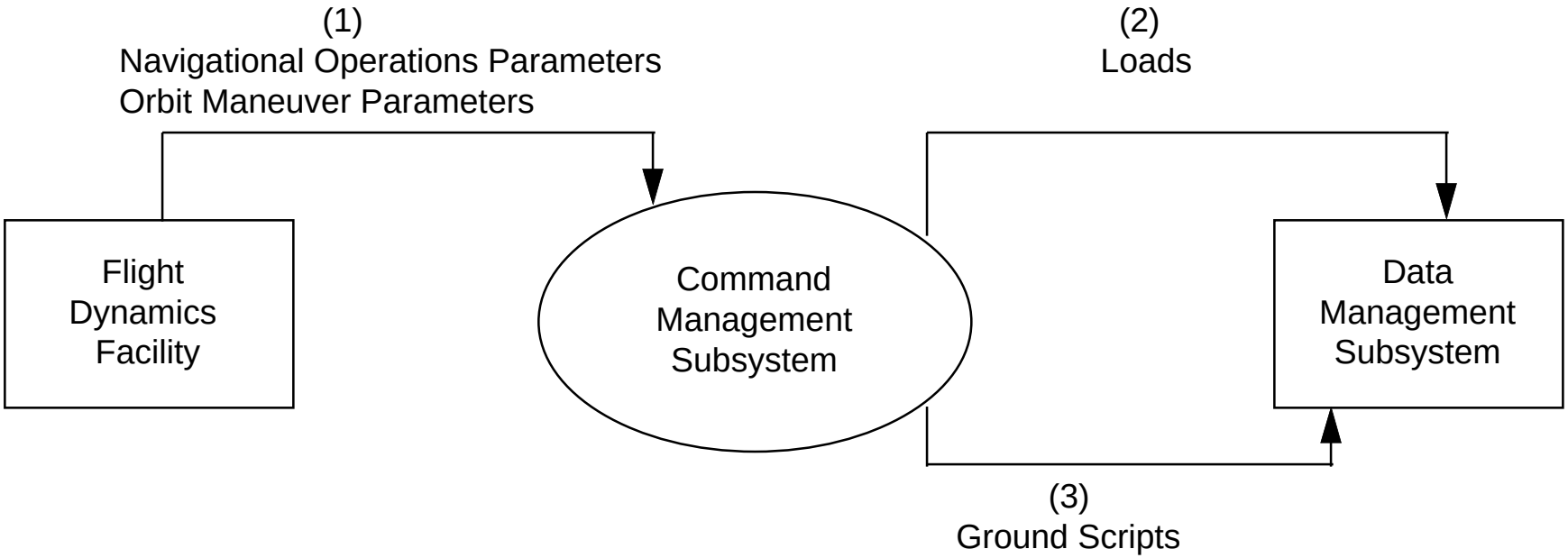


Generation of load and ground script from Detailed Activity Schedule:

- **Planning and Scheduling provides Detailed Activity Schedule and externally-generated loads (1)**
- **CMS checks command-level constraints using Spacecraft Definition provided by Data Management and authenticates loads (2)**
- **CMS returns any conflict information to Planning and Scheduling (3)**
- **CMS generates Absolute Time Command (ATC) load and ground script using Spacecraft Definition and Cmd DB from Data Management**
- **CMS prepares loads for uplink**
  - **ATC load**
  - **Relative Time Sequence (RTS) load**
  - **Microprocessor load**
  - **Table load**
  - **Flight software load**
- **CMS stores the loads and ground script with Data Management (4)**


Command Control Display
File Utility
Help
ECS94187
Suspended
AM1173
OBP 1
Mode 1
Bias:
Time
Command/Directive
Status
Current Directive:
187/00:02:00 /MiCPSAa ENABLE
Selected Directive:
Command
Allow
Send
Cancel
Directive
Go
Yes
Jump
Disable
No
Clear
Schedule
Resume
CV:
Off
Kill
TV:
Off
CMD:
Close
Proc

CMS Table Load Generation Scenario

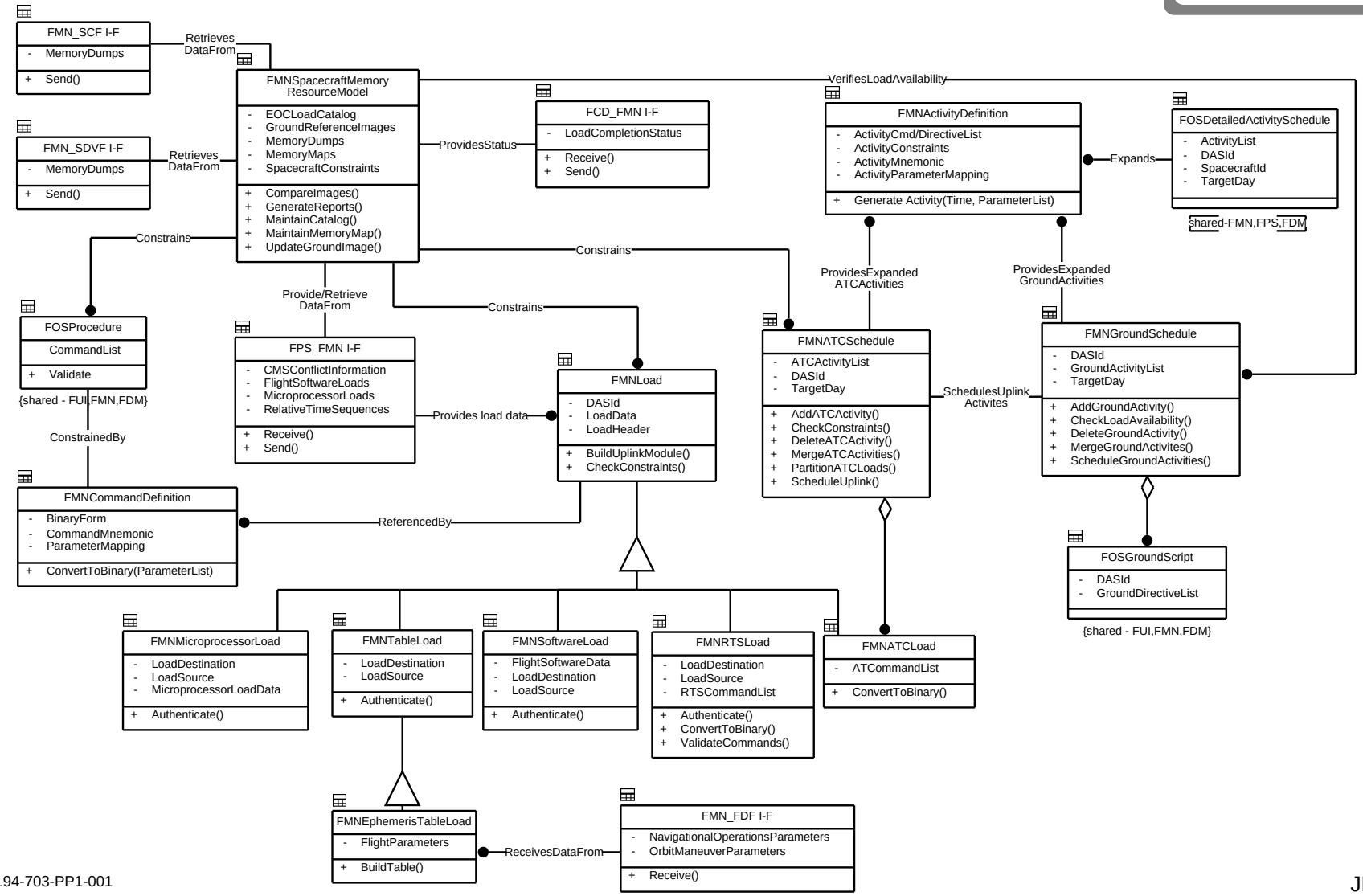


CMS Table Load Generation Scenario

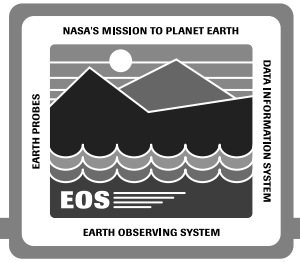
Generation of ephemeris table load from Navigational Operations Parameters:

- **FDF provides Navigational Operations Parameters (1)**
- **CMS generates ephemeris table load and stores it with Data Management (2)**
- **CMS adds uplink of ephemeris table load to ground script and stores it with Data Management (3)**

Command Management Object Model Diagram



Command Management Object Model Description



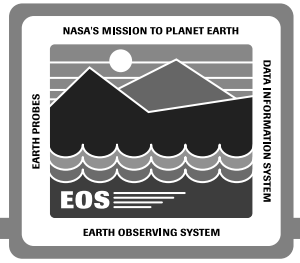
FMNSpacecraftMemoryResourceModel Class

- **Encapsulates functions requiring knowledge of spacecraft memory (Stored command buffer management, memory map reports, dump compare, constraint checking)**
- **Uses database-defined spacecraft constraints (e.g., spacecraft command execution rate)**

FMNLoad Class Hierarchy

- **Superclass builds uplink modules for all types of loads**
- **Subclasses handle individual types of loads**
- **New load types can be added to hierarchy without impacting FMNLoad superclass**

Command Management Object Model Description (cont.)



FMNActivityDefinition Class

- **Expands each activity in Detailed Activity Schedule**
- **Each activity in DAS expands to ATC activity or ground activity or both**
- **Activity expansion is database-driven, can accommodate new spacecraft and instruments with new database**

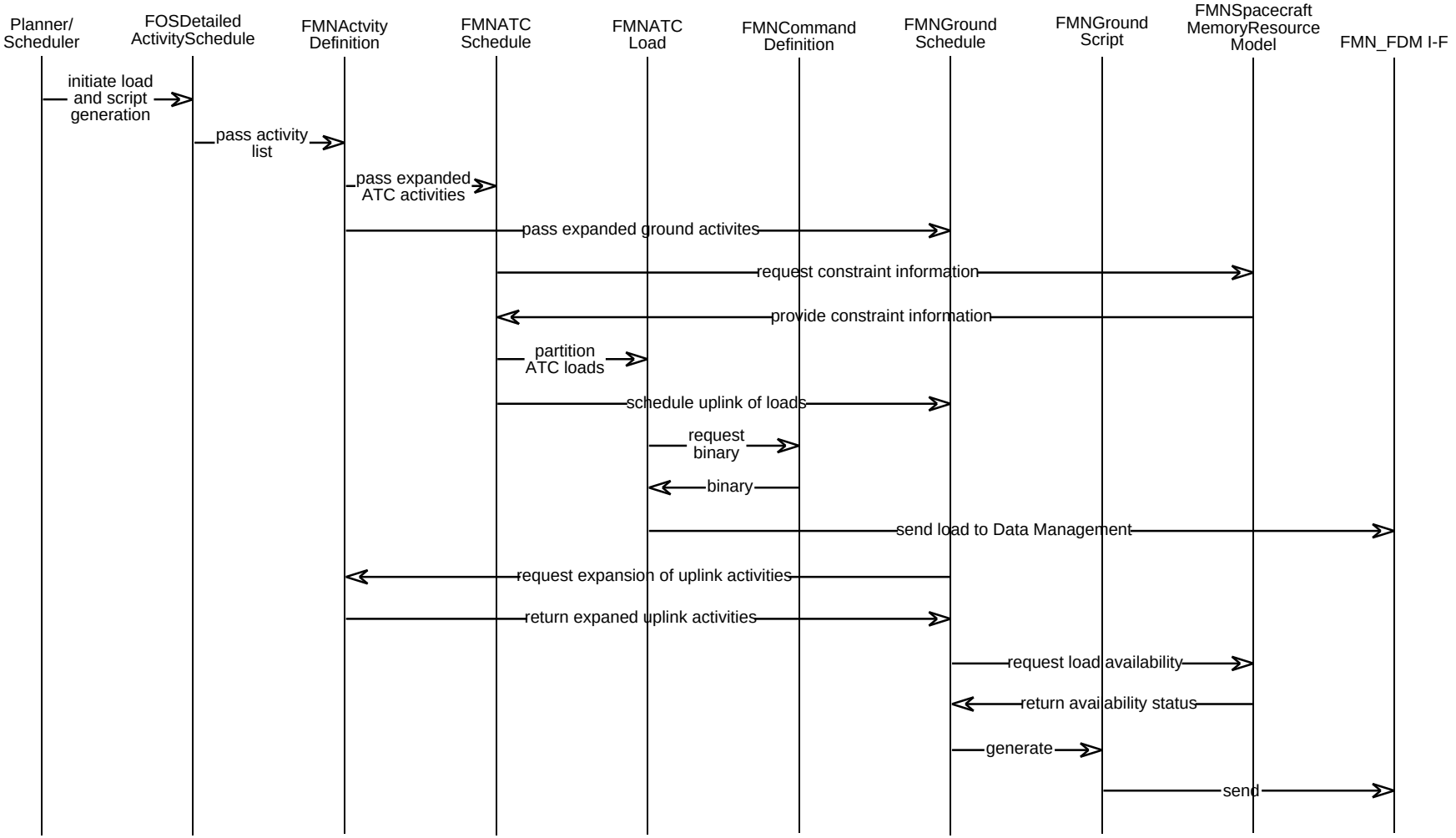
FMNATCSchedule Class

- **Builds Absolute Time Command load from Detailed Activity Schedule**
- **FMNATCSchedule will become superclass in a hierarchy**
- **Subclasses will be derived to meet ATC buffer management requirements for specific EOS spacecraft (e.g., ATC buffer for AM-1 holds 3000 commands in time order) without impacting the superclass**

FMNGroundSchedule Class

- **Builds ground script that corresponds to ATC load from Detailed Activity Schedule**
- **Provides increased automation of real-time contact operations**

Command Management Scenario Detailed Activity Schedule



CMS Detailed Activity Schedule Processing Scenario

EOC Planner/Scheduler initiates load and ground script generation

Each activity in DAS is expanded to list of commands (ATC Schedule) or ground directives (Ground Schedule)

ATC Schedule queries Memory Resource Model for constraint information

Loads are partitioned as necessitated by:

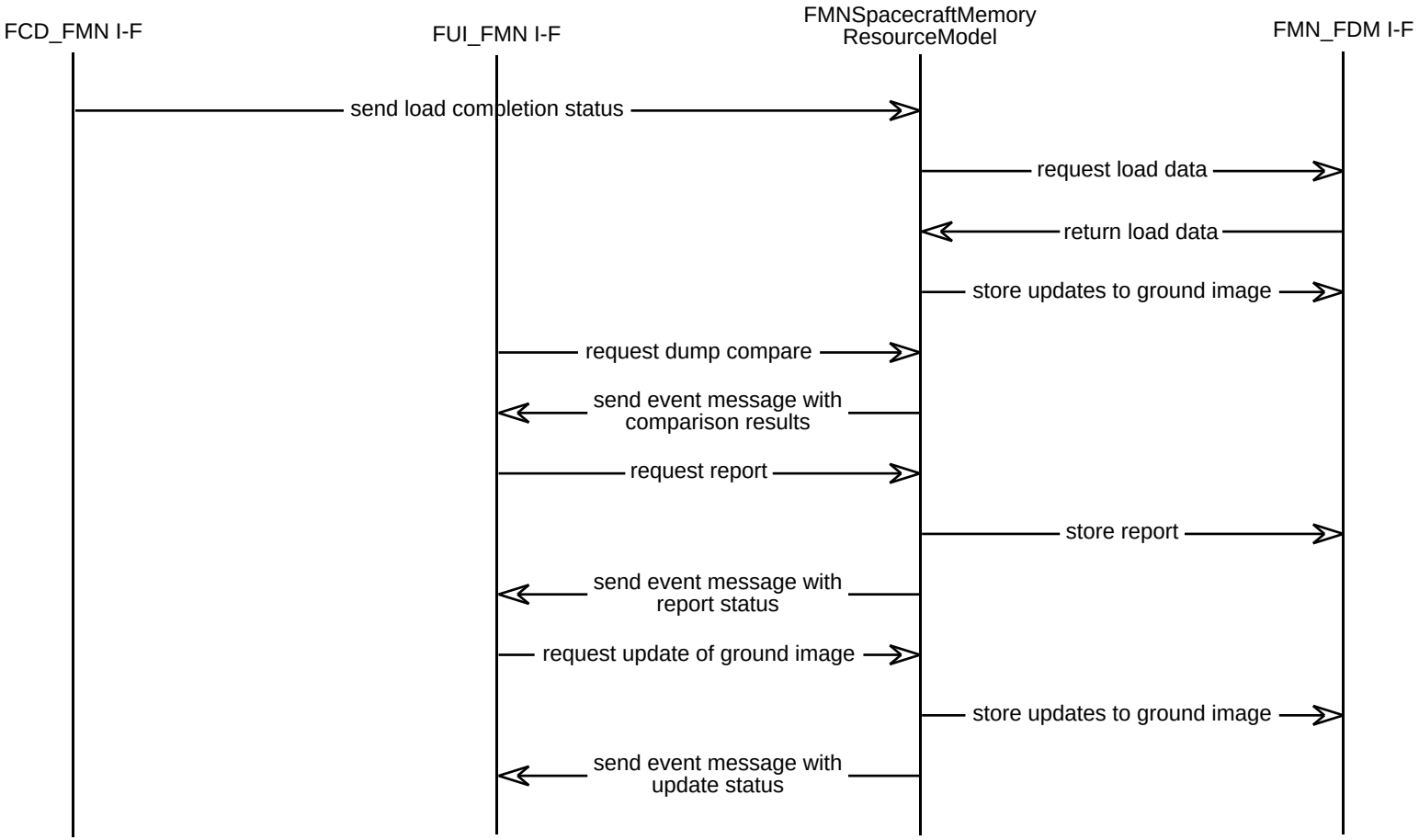
- On-board available buffer space
- Available uplink time

Loads are prepared for uplink

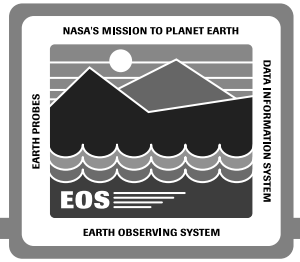
- Converted to binary if necessary
- Placed in CCSDS packets

Load uplink activities are added to the Ground Schedule

Command Management Scenario Memory Image Processing



CMS Memory Image Processing Scenario



- Upon successful uplink, Command subsystem provides a load complete status to CMS
- Spacecraft Memory Resource Model obtains load data from Data Management and updates corresponding area of ground reference image
- On request from the User Interface Subsystem, the Spacecraft Memory Resource Model compares a dump image to a corresponding area of the ground reference image
- The Model returns an event message summarizing the comparison results
- On request, the Model generates a detailed report listing addresses and content of miscompared locations
- On request, the Model updates an area of the ground reference image